



Understanding the Details of Nuclear Weapon Performance

In 1995, the Stockpile Stewardship Program formally began when President Clinton reached two critical decisions that established the course for future nuclear-weapons activities in the United States. At the time, both the U.S. and Russia were reducing the size of their nuclear arsenals, both nations had been observing a moratorium on nuclear testing for three years, and the U.S. had halted its programs to develop new nuclear weapons.

First, on August 11, 1995, the President announced that the U.S. would pursue a Comprehensive Nuclear Test Ban Treaty. In making that decision, he also reaffirmed the importance of maintaining a safe and reliable nuclear weapons stockpile. Then, on September 25, 1995, the President directed necessary programmatic activities to ensure continued stockpile performance. Under the leadership of Vic Reis, the Department of Energy's Assistant Secretary for Defense Programs, DOE national security laboratories and the weapons production facilities worked with DOE Defense Programs and the Department of Defense to formulate the Stockpile Stewardship Program.

The program was launched as an ambitious effort—not without risks—to significantly improve the science and technology base for making informed decisions about an aging nuclear weapons stockpile without relying on nuclear testing. All aspects of weapons must be understood in sufficient detail so that weapons experts can assess the performance of the nation's nuclear weapons with confidence and make informed decisions about refurbishment, remanufacture, or replacement of weapons as needs arise.

To succeed, the three DOE national security laboratories, now part of the National Nuclear Security Administration, needed much more advanced experimental and computational capabilities. At Livermore, the National Ignition Facility is under construction (see Year 1997), and new supercomputers are being acquired as part of the Advanced Simulation and Computing (ASCI) program (see Year 2000). As new capabilities are coming on line, they are contributing to surveillance of stockpiled weapons to determine their condition, assessment of weapon safety

and reliability, activities to extend the lifetime of weapons, and certification of refurbished warhead systems. The new experimental and computational capabilities also are being used to train and evaluate the skills of the next generation of stockpile stewards, who depend on these tools to help maintain the nuclear stockpile.

To date, the Stockpile Stewardship Program is making excellent technical progress. For example, researchers are dramatically improving their understanding of the properties and aging of materials in weapons, and the sophistication and resolution of three-dimensional simulations of weapon performance are rapidly increasing. In addition, Livermore has successfully completed engineering development work on its first stockpile life-extension program (see Year 1986). However, many of the toughest challenges probably lie ahead as weapons continue to age. The long-term success of stockpile stewardship depends on a continuing strong national support for the program and on the skills and capabilities of future generations of weapons experts at the nuclear weapon laboratories.



Expansion of Livermore's computing power requires construction of the \$92-million Terascale Simulation Facility (TSF), which began in April 2002 with a groundbreaking ceremony. The TSF is designed to accommodate a 60- to 100-teraops machine (ASCI Purple) that will move scientists closer to the goal of performing full-scale simulations of weapon performance based on first-principles physics. The TSF will also house a growing support staff and researchers who work on projects such as developing new tools to assimilate the vast amount of data generated.



The Livermore Superblock (far left) is home to one of only two defense plutonium research and development facilities in the U.S. For the nation's Stockpile Stewardship Program, trained fissile material handlers prepare samples for nonnuclear tests (left), conduct experiments to study the properties of plutonium, and examine parts of selected weapons from the stockpile for signs of aging (above).